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OCT 25 1989

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METALS

Light Metals

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Examination of the Shot Peening Process

The results of an extensive study of the shot peening process conducted by investigators at Advanced Material Process Corporation for the Air Force under the Small Business Innovative Research Program are described in a technical report issued recently.⁽¹⁾ The objective of these studies was to develop a data base from which a mathematical model could be developed relating fatigue life to shot peening variables.

Tension-tension fatigue specimens (R = 0.1) were prepared from eleven different titanium alloys, aluminum alloys, or steels and given various types of controlled shot peening treatments. Fatigue properties of these specimens were then determined and correlated with shot peening variables. Most of the materials behaved similarly in that shot peening first increased, then decreased fatigue life as peening intensity increased. An exception was unalloyed titanium which showed a progressive decrease in fatigue life with increased shot peening. The existence of an optimum intensity shot peening range for most of the materials was related to whether fatigue initiated at the surface or internally. At low intensities, fatigue tended to initiate at the surface. As shot peening intensity entered

(1) Simpson, R. S., and Chiasson, G. L., "Quantification of the Effects of Various Levels of Several Critical Shot Peen Process Variables on Workpiece Surface Integrity and the Resultant Effect on Workpiece Fatigue Life", AFWAL-TR-88-3029, October 31, 1988.

the optimum range, initiation occurred internally with significant increases in fatigue life. At still higher intensities, surface initiation was again observed, originating from surface defects designated as "peened surface extrusion folds" and fatigue life was reduced to values below that of unpeened material.

Several observations were made in this report that will be of interest to those involved with shot peening processes. For example, it was shown that shot peening intensity as defined by the standard Almen test has varying effects on the fatigue properties of peened specimens. This was attributed to the effect on peening saturation of the difference between the hardness of the Almen test specimen (e.g., a 1020 steel) and the hardness of the material being peened. The relationship between Almen saturation and material saturation as a function of material hardness is shown in Figure 1. It was also shown that there was little effect of the type of shot or the shot size on the fatigue properties of shot peened materials when peening was conducted within the optimum intensity range. Surface finish prior to shot peening had a significant effect on the optimum intensity range, the poorer the initial surface condition, the higher the optimum intensity range. Surface finish did not affect fatigue life however, assuming that the parts were peened within the optimum intensity range. Factors that tended to reduce fatigue life included fragmentation of shot and decreased impact angle.

Although the investigation has not yet resulted in the development of a model relating shot peening parameters to fatigue performance of peened parts, the authors include considerable discussion in this report of the significance of their findings and how the results may be used to achieve improved benefits from shot peening.

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